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# Cigarette Smoking and Skin Prick Test in Patients With Allergic Rhinitis

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**Background:** Allergic Rhinitis (AR) is the most common allergic disease, affecting 30% of population around the world. The disease is predominantly associated with exposure to some aeroallergens like cigarette smoking. Skin Prick Test (SPT) is a method of detecting immediate allergic reactions and is applied for controlling disease and therapeutic modality.
**Objectives:** This study was designed to investigate the effect of cigarette smoking on SPT results among male and female individuals with AR disease.
**Patients and Methods:** A total of 478 patients with AR admitted to the 2 main hospitals of Zahedan City from 2005 to 2012, were recruited in this analytic-descriptive study. Categories of smokers and never smokers were used based on patient's statements and their history of smoking. SPT was performed with panel of some allergens and results were recorded and analyzed statistically. Odds ratio and confidence interval method were calculated using univariate logistic regression.
**Results:** The results of this study indicated that 41.4% of patients with allergic rhinitis was smoker with ages ranged from 15 to 70 years. The result of this study also showed that smoking has no effect on SPT results of pollen and weeds aeroallergens conducted on male and female AR patients. However, male were significantly more sensitive than female in terms of sensitivity to the *aspergillus, cladosporium,* house dust mite, grasses, wheat, cockroach, and feather allergens.
**Conclusions:** Our findings did not support the effect of cigarette smoking on SPT reactivity to pollen and weeds aeroallergens. However, male were significantly more sensitive than female in terms of sensitivity to some allergens.

*Keywords:* Cigarette Smoking; Hydrothermal Vents; Rhinitis, Allergic

## 1. Background

Allergic Rhinitis (AR) is usually defined as the presence of at least one or more of the symptoms of congestion, rhinorrhea, sneezing, nasal itching, and nasal obstruction (1, 2). The disease is an Immunoglobulin E (IgE) mediated reaction of Th2-type T cell response (3, 4).

The disease has various effects on patients' quality of life (5, 6). It is divided into two aspects as seasonal and perennials and its prevalence has been increased over the last 4 decades in both industrialized and developing countries (7, 8).

Based on the World Health Organization report in 2013, the prevalence of seasonal and perennial nasal symptoms is estimated 30% in the United States, 20% in Europe, 9% in different parts of the Middle East, 36% in Al-Ain City (Abu Dhabi), and 7% in the United Arab Emirates (9).

The prevalence of AR in Iran has been reported as follows: 34.3% among high school students in Hamadan City, 35.3% among 12 - 13 years old children in Gorgan City, and 19.3% among high school students in Kerman City (6). In Zahedan, based on a report in 2003, a large number of allergens and high prevalence of AR disease have been recorded (74.5%) among the study population that was attributed to geographical problems such as dry climate and dusty area (10).

Nasal hyperresponsiveness to various agents named as allergens is quite common in allergic rhinitis. These allergens comprise aeroallergens such as trees, grasses, weeds, molds, air pollution (11), house dust mites, feather, and animal dander (12).

Among them, tobacco smoke is one of the known inhaled allergens that has been associated with high prevalence of allergic diseases and has various effects on the quality of life of smokers as well as persons who are not smoking and classified as passive smokers (13). Tobacco contains more than 7000 chemicals, 60 known or suspected carcinogens and is responsible for approximately one-third of all cancer deaths annually. By the way, if someone puffs once on a cigarette, this will cause DNA damage and if he wishes to continue, then this will overwhelm DNA repair mechanisms, leads to genetic alterations and resulting in allergic rhinitis and other illnesses (14). Investigations have sought to study the harmful effects of tobacco smoke on

rhinitis and allergic sensitization as well as how smoking correlates with prevalence of allergic rhinitis, however the results are controversial (15, 16).

To confirm the presence of AR disease, the most common diagnostic test is Skin Prick Test (SPT) (17, 18) that is simple, easy, comfortable, inexpensive, safe, most reliable, and effective. It is an appropriate diagnostic and rapid method of investigation of all type 1 hypersensitivity reaction to a specific allergen (17, 19, 20).

## 2. Objectives

This study was designed to understand the role of smoking in response to some aeroallergens, and to determine if there is any difference in response to some allergens between cigarette and non-cigarette smokers suffered from allergic rhinitis.

## 3. Patients and Methods

This population-based observational study is cross-sectional and analytic descriptive. It was carried out on 478 adult patients with symptoms of allergic rhinitis referred to the immunology and allergy clinic of 2 main hospitals of Zahedan City, Iran between 2005 and 2012. The diagnostic criteria were based on standard gold criteria defined as the presence of at least one of the symptoms of congestion, rhinorrhea, sneezing, nasal itching, and nasal obstruction (1) diagnosed through physical examination by specialized physicians. Individuals without clear symptoms of AR were excluded from the study. Then, the patients were divided into two groups as smoker and nonsmoker based on patient's statements and their history of smoking. After taking consent letter from the patients, questionnaires, containing demographic data, main chief complaint, patient's history, season and duration of disease and family history of allergic rhinitis diseases were distributed among patients and completed by them. Exclusion criteria included lack of suffering from AR symptoms; having pulmonary diseases like COPD, emphysema, chronic bronchitis; having some inflammatory diseases such as rheumatoid arthritis, inflammatory diseases of the stomach; lack of cooperation in the project; and transference of patients from other cities or provinces of the country.

To confirm allergic rhinitis and providing an appropriate treatment, SPT was performed with some available aeroallergens for each patient using a standard allergen extract panel (purchased from French Staller genes Company). Positive and negative control comprising histamine and distilled water, respectively were also performed. Aeroallergens like house dust mite, pollens, *alternaria*, *aspergilus*, *cladosporium*, grasses, weeds, wheat, cockroach, and feathers all were used for each patient. The method of SPT was applied on the anterior surface of the forearm and skin reactions were evaluated 20 minutes after the application of the skin test and considered positive when the reaction of redness and wheal was observed based on the reports of Dogru et al. and Hosseini et al. (17, 18). The results were analyzed statistically by descriptive statistics method as well as odds ratio and confidence interval using univariate logistic regression model via SPSS software (version 18).

## 4. Results

Of 478 patients with allergic rhinitis, 278 (58%) were male and 200 (42%) female with ages ranged from 15 to 70 years. A total of 198 (41.4%) patients were smokers. Among them 148 (75.5%) patients were male. Additionally, the result of SPT reactivity showed variable responses to different allergens among individuals as in AR smokers, the highest response was seen with *aspergillus* (79.3%) and lowest with weeds (17.9%) aeroallergens, whereas in non-smokers the highest response was seen with house dust mite (36.5%) and lowest with *alternaria* (17.2%) aeroallergens. Table 1, lists the results of SPT response to allergens in smokers and non-smokers patients based on sex, SPT response, and percentage of patients.

**Table 1.** Comparison of SPT Reactivity to Allergens Among Smoker and Non-Smoker Patients [a]

| | Patient and Gender | | | | | |
|---|---|---|---|---|---|---|
| | Smokers | | | Non-smokers | | |
| SPT With Allergens | Male | Female | SPT Response | Male | Female | SPT Response |
| ***Aspergillus*** | 57.1 | 42.9 | 79.3 | 63.1 | 36.9 | 27.4 |
| ***Cladosporium*** | 69.5 | 30.5 | 67.6 | 56.4 | 43.6 | 24.7 |
| **House dust mite** | 54.3 | 45.7 | 67.3 | 64.3 | 35.7 | 36.5 |
| ***Alternaria*** | 67.2 | 32.8 | 56.6 | 51.8 | 48.2 | 17.2 |
| **Pollen** | 61.2 | 38.8 | 32.9 | 46.9 | 53.1 | 26.7 |
| **Grasses** | 50.1 | 49.9 | 30.2 | 57.3 | 42.7 | 17.8 |
| **Weeds** | 53.2 | 46.8 | 17.9 | 48.5 | 51.5 | 21.8 |
| **Wheat** | 58.1 | 41.9 | 31.1 | 53.3 | 46.7 | 28.9 |
| **Cockroach** | 52.2 | 47.8 | 27.9 | 61.8 | 38.2 | 23.9 |
| **Feather** | 63.1 | 36.9 | 19.8 | 57.2 | 42.8 | 31.6 |
| **Total** | 41.4 | 41.4 | 41.4 | 58.6 | 58.6 | 58.6 |
| **P-value** | 0.001 | 0.001 | 0.001 | 0.491 | 0.491 | 0.491 |

[a] Values are presented as % except P value.

Furthermore, the result of statistical analysis of odds ratio and confidence interval with respect to sex and smoking based on univariate logistic regression model, indicated that smoking has no effect on SPT results. Also, there was no significant difference between male and female with respect to sensitivity to pollen and weeds aeroallergens. However, males were significantly more sensitive than females with respect to the *aspergillus*, *cladosporium*, house dust mite, grasses, wheat, cockroach, and feather allergens (Table 2).

**Table 2.** Odds Ratio and Confidence Interval for Sex and Smoking Based on Univariate Logistic Regression Model [a]

| SPT With Allergens | Gender | Smoking |
|---|---|---|
| | OR, 95% CI | OR, 95% CI |
| ***Aspergillus*** | 2.43 [b] (1.66, 3.55) | 1.12 (0.78, 1.61) |
| ***Cladosporium*** | 2.96 [b] (2.02, 4.35) | 1.27 (0.88, 1.83) |
| **House dust mite** | 2.33 [b] (1.59, 3.40) | 1.05 (0.73, 1.52) |
| ***Alternaria*** | 1.84 [b] (1.27, 2.68) | 1.39 (0.96, 2.00) |
| **Pollen** | 1.23 (0.85, 1.78) | 1.27 (0.88, 1.83) |
| **Grasses** | 1.87 [b] (1.28, 2.73) | 1.08 (0.75, 1.55) |
| **Weeds** | 1.03 (0.71, 1.49) | 1.08 (0.80, 1.55) |
| **Wheat** | 1.50 [b] (1.04, 2.18) | 1.16 (0.81, 1.67) |
| **Cockroach** | 2.07 [b] (1.42, 3.02) | 1.07 (0.74, 1.54) |
| **Feather** | 2.13 [b] (1.46, 3.10) | 1.26 (0.87, 1.81) |

[a] Abbreviations: CI, Confidence Interval; OR, Odds Ratio.
[b] Significant level is 5%.

## 5. Discussion

This study was carried out to evaluate effects of smoking on SPT reactivity to some allergens in male and female patients who suffered from allergic rhinitis. Little is known about the impact of smoking on reactivity to some available aeroallergens in AR smokers and non-smokers. In previous studies, the impact of smoking habits on allergic rhinitis and asthma diseases, has been reported (21, 22), but their results are controversial because some showed a significant association, whereas others did not. Accordingly as we mentioned, the potential role of cigarette smoking in allergic rhinitis is still not obscure. In fact, the risk for the disease will be decreased more with quit cigarette smoking but still in a few patients with AR, they are more likely to develop allergic rhinitis and later asthma disease (23).

Thus, association between smoking and allergic rhinitis, has been reported with a high prevalence of chronic rhinitis in both men and women and a low prevalence of allergic rhinitis in men as reported by Eriksson J et al. in 2013 (15). However, these associations have been dose dependent and remained when adjusting a number of possible confounders in multiple logistic regression analysis. They also reported that prevalence of chronic rhinitis was the lowest in nonsmokers and highest in heavy smokers and prevalence of sensitization to common airborne allergens was lower in current smokers compared to nonsmokers. More recently a study examined the relationship between allergic rhinitis among smokers and nonsmokers and their findings suggest that cigarette smoking is associated with allergic rhinitis (2).

On the other hand, to understand better the role of smoking on SPT results in allergic rhinitis we examined the role of SPT reactivity to some allergens in patients with AR. In fact, Eriksson NE and Holmen A were the first in 1996 who have reported the SPT results with standardized extracts of inhalant allergens in 7099 adult patients with asthma or rhinitis (24). Since that time some other investigators have studied the role of SPT in young adult's AR patients with allergic rhinitis in combination with the effect of stress and anxiety on positive skin test responses (21) and some others have investigated the SPT reactivity to common aero and food allergens among children with allergy (18). But their results are controversial. Despite that, our study has focused on the role of smoking on SPT results in male and female patients with allergic rhinitis. Our results firstly confirmed that 41.4% of patients were smokers that most of them were male and statistically significant differences between gender and smokers were observed ($P < 0.001$). This result is consistent with studies of Hosseini et al. and Saleh et al. (18, 19). Furthermore, our study showed that gender and smoking were related to the prevalence of allergic rhinitis among male patients and this result is also consistent with other studies (2, 22-25). However, it is inconsistent with the study of Eriksson J et al. (15), in which the prevalence of chronic rhinitis was high whereas the prevalence of allergic rhinitis was low in male cigarette smokers.

Secondly, our results showed a significant association between positive reactivity of patients to *aspergillus*, *cladosporium*, house dust mite, grasses, wheat, cockroach, and feather allergens between smoker and nonsmoker patients adjusted for male gender (Table 2). This finding has not introduced elsewhere and the reason for this may be related to the different role of tobacco smoke in health as reported by Warren et al. (14) and the role of gender, especially male gender. In addition, there was no significant difference between male and female with respect to the sensitivity to pollen and weeds aeroallergens (Table 2), but these results also are not reported elsewhere and is consistent with the study of Asero et al. in which they indicated that the clinical relevance of hypersensitivity to pollen pan allergens is similar in men and female patients suffered from pollen allergy (26). This result is also partially consistent in terms of gender with the study of Paulose-Ram R et al. who showed that cigarette smoking has been associated with some demographic parameters of smokers such as age, gender, race, and degree of education (27).

So it can be said that aeroallergens, especially these allergens play an important role in smoker AR than in nonsmok-

ers. Thus, for better diagnosis and treatment of patients with AR such procedures as avoiding allergens, using antihistamines, taking anti-inflammatory drugs, and following immunotherapy programs are highly recommended.

Furthermore, some confounding factors in this study were included such as lack of patient cooperation in collecting accurate data on the number of cigarettes consumed, their underlying diseases, presence or absence of risk factors according to the patients' statement at reception, long term study, failure to investigate some effective demographic factors associated with disease and the relatively high cost of testing (As the test was costly, time consuming, some uncooperative patients in their next visit did not control them).

Further study should be taken into consideration to better understand the role of aeroallergens by SPT method in smoker and nonsmoker patients with allergic rhinitis. This should be noted that other factors such as longer follow-up period, use of a comprehensive questionnaire, effect of potential confounding variables and use of statistical techniques to identify risk groups, must be investigated in future.

On the other hand, we did not examine smokers in terms of the number of cigarettes or packs of cigarettes used and also what is the effect of smoke in passive smokers and or the influence of smoking on disease intensity in smokers and nonsmokers. These issues should also be taken into consideration in future.

Our results support the effect of smoking in SPT results of the patients with AR and the most effective allergens in cigarette smoker patients were *aspergillus*, *cladosporium*, house dust mite, grasses, wheat, cockroach and feather allergens compared to nonsmokers. Thus we conclude that for controlling the disease in cigarette smoker patients, avoidances of such allergens following immunotherapy needs to be done.

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## Authors' Contributions

Hossein Ali Khazaei: Designing the project, doing the paraclinical investigation by SPT method, analyzing the data, and finally writing and correcting the paper. Bahman Khazaei: Collecting information from patients. Gholam Ali Dashtizadeh: Introducing patients and adjusting them with current diagnosis. Mahdi Mohammadi: assisting in analyzing data and writing and submitting the paper in collaboration with others.

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